



Engineering, Operations & Technology  
Boeing Research & Technology

Research & Technology

# The Nuts and Bolts of Zinc-Nickel

OEM Zinc Nickel Implementation on Fasteners – Getting It Into Production

Blake Simpson  
Louie Tran

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE <b>NOV 2014</b>		2. REPORT TYPE		3. DATES COVERED <b>00-00-2014 to 00-00-2014</b>	
4. TITLE AND SUBTITLE <b>The Nuts and Bolts of Zinc-Nickel: OEM Zinc Nickel Implementation on Fasteners - Getting It Into Production</b>				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>Boeing Research &amp; Technology,Engineering, Operations &amp; Technology,100 North Riverside,Chicago,IL,60606</b>				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release; distribution unlimited</b>					
13. SUPPLEMENTARY NOTES <b>ASETSDDefense 2014: Sustainable Surface Engineering for Aerospace and Defense, 18-20 Nov 2014, Fort Myer, VA.</b>					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>Same as Report (SAR)</b>	18. NUMBER OF PAGES <b>16</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			

# Agenda

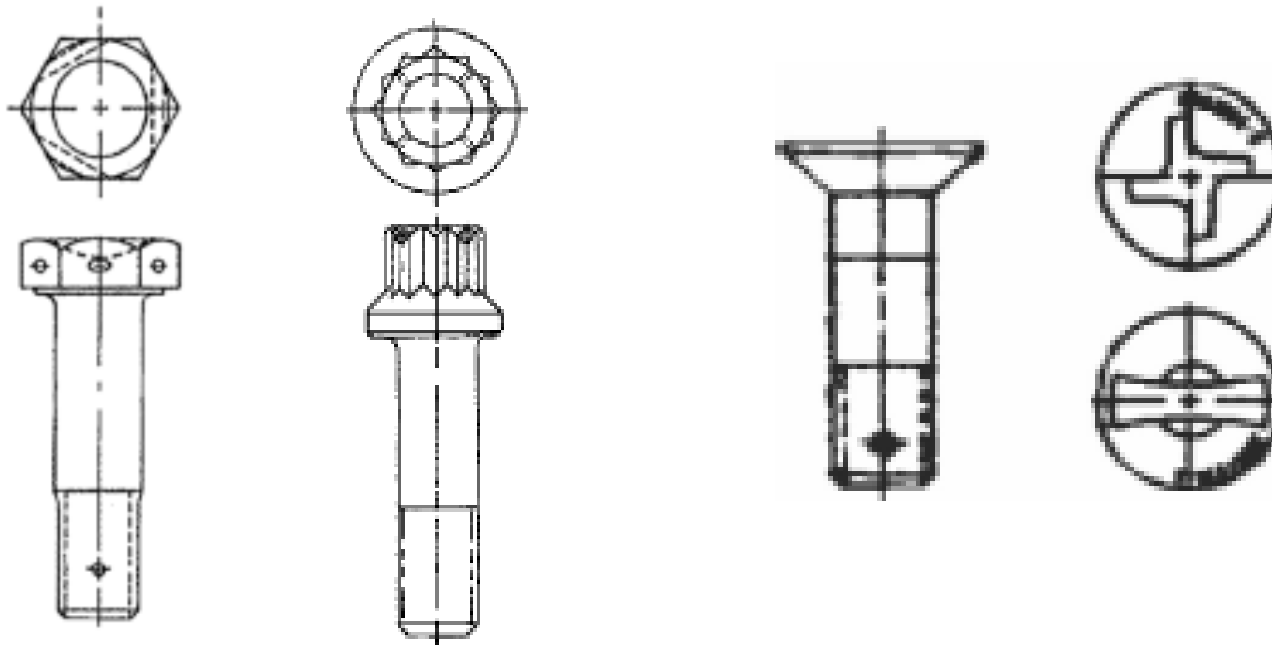
- 1. Cadmium Plated Fasteners currently in production**
- 2. Problem at Hand – Hexavalent Chromates**
- 3. Transition to Zinc-Nickel**
- 4. Preliminary Testing**
- 5. Plan moving forward for Qualifications and Implementation**

# Cadmium Plated Fasteners

Engineering, Operations & Technology | Boeing Research & Technology

Fasteners and Bearings Engineering

- **Bolts**



- **Screws**

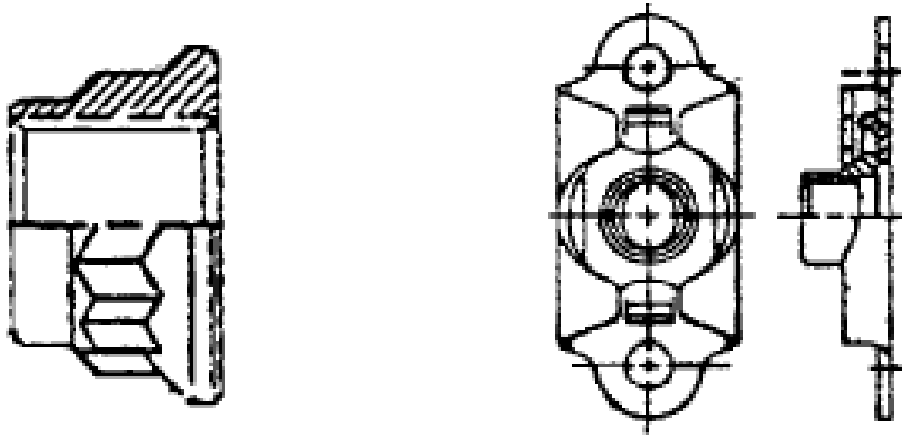


# Cadmium Plated Fasteners

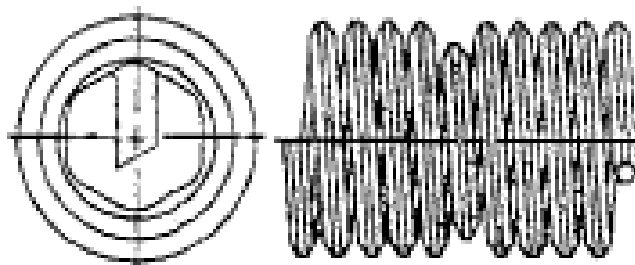
Engineering, Operations & Technology | Boeing Research & Technology

Fasteners and Bearings Engineering

- **Nuts/Nut Plates**



- **Inserts**

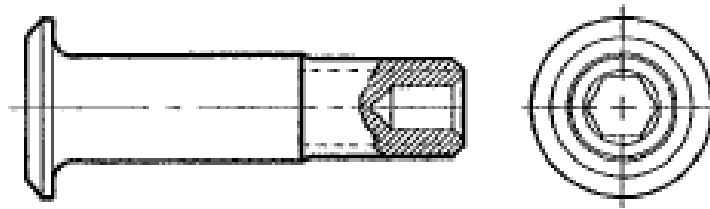


# Cadmium Plated Fasteners

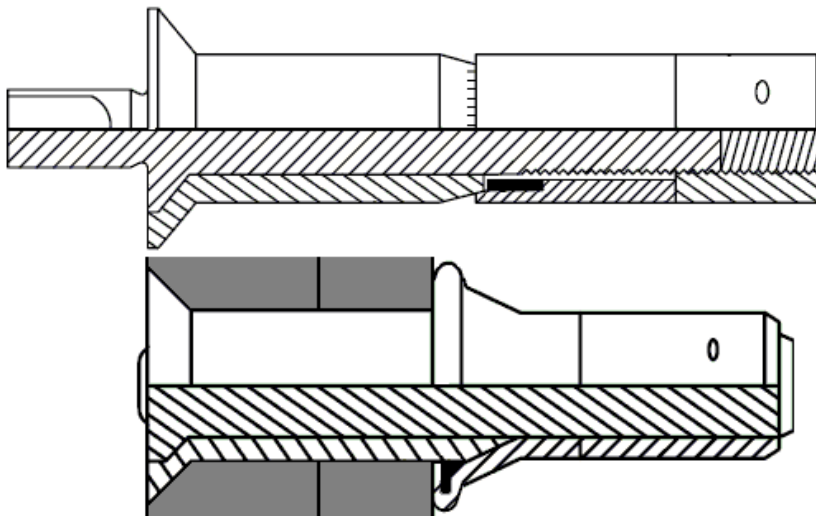
Engineering, Operations & Technology | Boeing Research & Technology

Fasteners and Bearings Engineering

- **Hi-Loks**



- **Blind Fasteners**



# ***Problem At Hand***

Engineering, Operations & Technology | Boeing Research & Technology

Fasteners and Bearings Engineering

## **REACH Initiative: Eliminate Hexavalent chromates**

**Cadmium Plating: September 21, 2017**



# Solution for Fasteners

Engineering, Operations & Technology | Boeing Research & Technology

Fasteners and Bearings Engineering

## Zinc-Nickel Plating



# Where is Zinc-Nickel used today?

Engineering, Operations & Technology | Boeing Research & Technology

Fasteners and Bearings Engineering

- **Low Strength Steel – just about everywhere**
  - Rod
  - Brackets
  - Baskets of Nut plates
- **High Strength Steel**
  - Landing gear
  - Flap tracks on wings

# So why not fasteners?

Engineering, Operations & Technology | Boeing Research & Technology

Fasteners and Bearings Engineering

# Threads

# What has Boeing done in preparation?

Engineering, Operations & Technology | Boeing Research & Technology

Fasteners and Bearings Engineering

**Goal: Zinc-Nickel Plated Fasteners to be a drop-in replacement for CAD Plated Fasteners**



*Boeing Research and Technology conducted 6 phases of testing before moving into qualification and implementation phase of Zinc-Nickel plating of threaded fasteners.*

# 6 Phases of Testing

- **Phase I – Failed, Acid based Zinc-Nickel, Fasteners were not representative of fasteners used in production**
- **Phase II – Failed, Acid based Zinc-Nickel, Results were not acceptable. Switch to Alkaline based Zinc-Nickel**
- **Phase III – Failed, Alkaline based Zinc-Nickel, Results Unacceptable**
- **Phase IV – Failed, Alkaline based Zinc-Nickel, Coating too thick**
- **Phase V – Failed, Alkaline based Zinc-Nickel, parts were stripped and re-plated (altered data)**

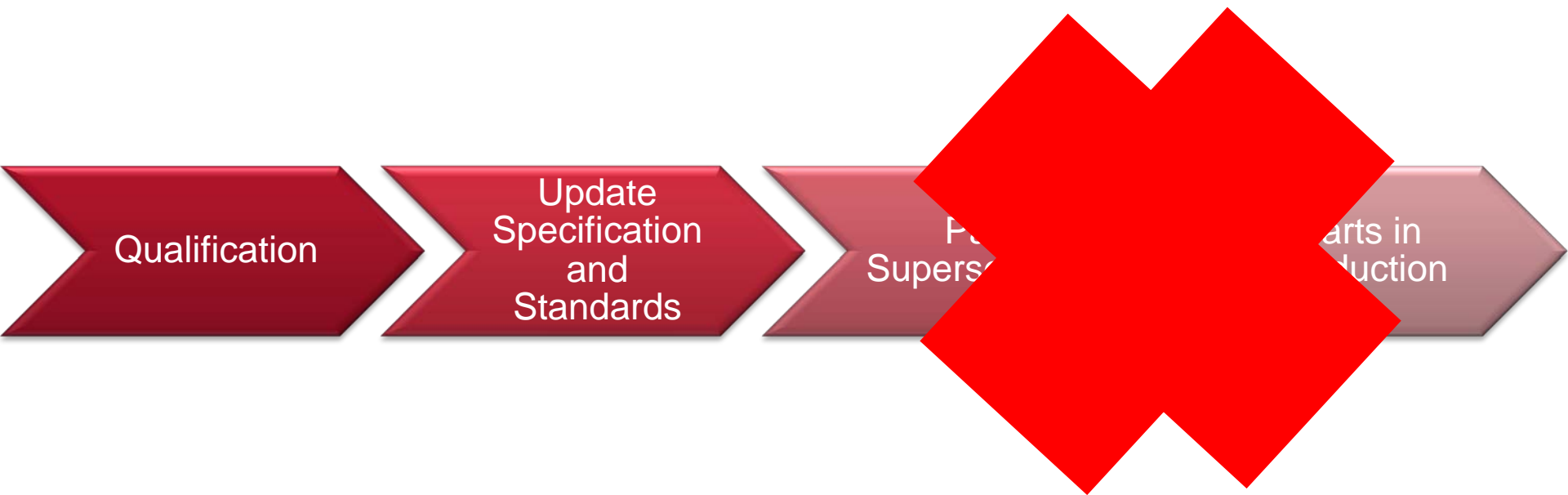
# Phase VI

1. Metallurgical Testing - thickness check      **Comparable**
2. Torque Tension – NASM1312-15      **Comparable, need more data**
  - 3 sizes, 6 tests configurations
3. High RPM Installation – galling check      **Comparable**
4. Torque Effectively and Reusability – BPS-N-70      **Crimp Optimization needed**
5. Salt Spray – NASM1312-1      **Comparable**
6. Installation Force – BMS10-85      **Further investigation needed with interference fit fasteners**

# What is the plan?

Engineering, Operations & Technology | Boeing Research & Technology

Fasteners and Bearings Engineering



**Qualification is not equal to Implementation**

1. Structures and design community risk adverse
2. Immature supply chain

# Where are we?

## Qualifications in-process

### 1) Bolts

- Thickness
- Appearance
- Dimensions
- Corrosion

### 2) Nuts

- Thickness
- Appearance
- Dimensions
- Torque Effectivity and Resuability – Adjust crimp factors
- Additional Torque Tension to complete data set

# Next Steps

- **Continue qualifying fasteners (hi-loks, collars, blinds, nut plates, inserts)**
- **Complete specification changes**
- **Complete torque tension data package during the qualifications**
- **Slowly get parts into production (Start with low risk parts and increase confidence) and build the supply chain**



# Questions???

Engineering, Operations & Technology | **Boeing Research & Technology**

**Fasteners and Bearings Engineering**